Title	<Nuclear Science Research Facility > Particle and Photon Beams
Author(s)	
Citation	ICR annual report (2004), 10: 62-63
Issue Date	2004-03
URL	http://hdl.handle.net/2433/65384
Right	
Type	Article
Textversion	publisher

Nuclear Science Research Facility
- Particle and Photon Beams -

http://wwwal.kuicr.kyoto-u.ac.jp/

Prof
NODA, Akira
(D Sc)

Assoc Prof
IWASHITA, Yoshihisa
(D Sc)

Instr
SHIRAI, Toshiyuki

Techn
TONGU, Hiromu

PD (NIRS)
TAKEUCHI, Takeshi
(D Sc)

Lecturer (pt)

Prof TANABE, Tetsumi (D Sc) KEK, Japan

Students

NAKAMURA, Shu (D2)
YAMAZAKI, Atsushi (D1)
TANABE, Mikio (M1)
FADIL, Hicham (D2)
FUJIMOTO, Shinji (D1)
IKEGAMI, Masahiro (D2)
MIHARA, Takanori (M2)

Visitors

Dr SYRESIN, Evgeny	JINR, Dubna, Russia, 9 January, 29 August - 3 September, 2003
Dr SHCHAGIN, Alexander V.	Kharikov Institute of Physics and Technology, Ukraine, 10 February, 2003
Prof ROTH, Markus	Technische Universität Darmstadt, Germany, 17-21 February, 2003
Prof MESHKOV, Igor N.	JINR, Dubna, Russia, 7 May, 2003
Dr GRIESER, Manfred	MPI für Kernphysik, Heidelberg, Germany, 12 -16 May, 2003
Dr REISTAD, Dag	The Svedberg Laboratory, Uppsala, Sweden, 16 May, 2003
Dr KAPIN, Valeri	Moscow Engineering Physics Institute, Russia, 19 September, 2003
Prof SHEVELKO, Viatcheslav P.	P.N. Lebedev Physical Institute, Moscow, Russia, 16 October, 2003
Prof BULANOV, Sergei V.	Institute of General Physics, Moscow, Russia, 11 December, 2003

Scope of Research

Particle and photon beams generated with accelerators and their instrumentations both for fundamental research and practical applications are studied. The following subjects are being studied: Beam dynamics related to space charge force in accelerators: Beam handling during the injection and extraction processes of the accelerator ring: Radiation mechanism of photons by electrons in the magnetic field: R&D to realize a compact synchrotron dedicated for cancer therapy; and Irradiation of materials with particle and photon beams.

Research Activities (Year 2003)

Presentations

Approach to ultra-cold beam at LSR, Kyoto University, Noda A, Joint 28th ICFA Advanced Beam Dynamics & Advanced & Novel Accelerators Workshop on QUANTUM ASPECTS OF BEAM PHYSICS, 11 January, 2003.

Laser-Produced Ion Beam Combined with the RF Accelerator, Noda A, Nakamura S *et al.*, Joint 6th ICFA Advanced & Novel Accelerators and 29th ICFA Advanced Beam Dynamics Workshop on Laser-Beam Interactions, 11 July, 2003.

Ion beam cooling at S-LSR project, Noda A, Shirai T, Fadil H, Ikegami M, Takeuchi T, Noda K, Grieser M *et al.*, The International Workshop on Beam Cooling, 20 May, 2003.

Hot Ion Beam Electron Cooling Experiments at TSR, Fadil H, Shirai T, Noda A, Grieser M *et al.*, Annual Meeting Phys. Soc. Jpn., 29 March, 2003.

Design of Compact Ion Cooler Ring, LSR for Beam Physics, Shirai T, Ikegami M, Takeuchi T, Tongu H, Noda A *et al.*, Annual Meeting Phys. Soc. Jpn., 29 March, 2003.

Nondestructive Electron Beam Monitor using MCP, Fujimoto S, Shirai T, Iwashita Y, Noda A, Annual Meeting Phys. Soc. Jpn., 29 March, 2003.

Design of Bending Magnet for Ion Storage Ring, LSR, Ikegami M, Shirai T, Takeuchi T, Tongu H, Noda A *et al.*,

Ion Cooler Ring, S-LSR

Particle beams generated by an accelerator behave like rays on the laboratory system but on the center-of-mass system of the beams, the motions of the particles are random and independent between each other. This status corresponds to the gas phase of the matter. The reduction of the relative motion of the particles is one of the most important subjects of the beam physics. It leads to the reduction of the beam size and the increase of the beam density. The ultimate limit of the reduction of the relative motion and the increase of the ion density is a phase transition to a liquid phase and a crystal phase.

Recently the molecular dynamics computer simulations predict the possibility of such phase transitions of the ion beams [1]. The required conditions are a strong beam cooling and a small heating from an accelerator. A laser cooling method is best suited for the first condition. It is applicable for the storage ring, not only for the ion trap [2]. In the second condition, the beam heating comes from the various field errors in the accelerator. The important point is not only decreasing the field error, but also avoiding the resonance between the particle motions and the field errors. From the simulations, the smaller betatron phase advance in an accelerator is considered to be better to avoid the resonane. The predicted upper limit of the phase advance is 127 degree per period [1].

The new ion cooler ring (S-LSR) is under construction at Nuclear Science Research Facility, Institute for Chemical Research [3]. Figure 1 shows the illustration of the ring. Its circumference is 22.557m. It has a laser cooler for Mg^{+} with the laser wavelength of 280 nm. The ring satisfies the phase advance less than 127 degrees and its minimum phase advance is 87 degrees [4]. High precision of the magnet fabrications, stable power supplies and good alignments are in pursuit for the small field errors. Figure 2 shows the photograph of the bending magnet and the quadrupole magnet. The deviation of the magnetic field strength among

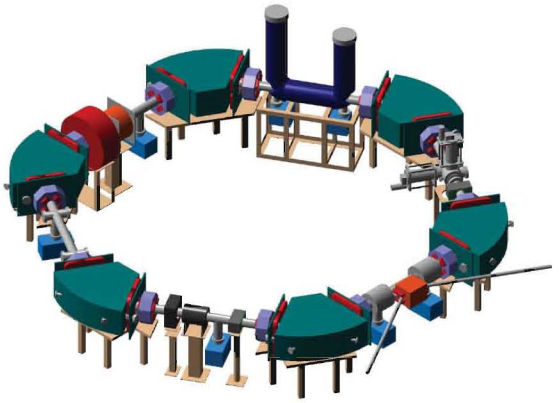

Figure 1 Schemmatic view of new ion cooler ring, S-LSR

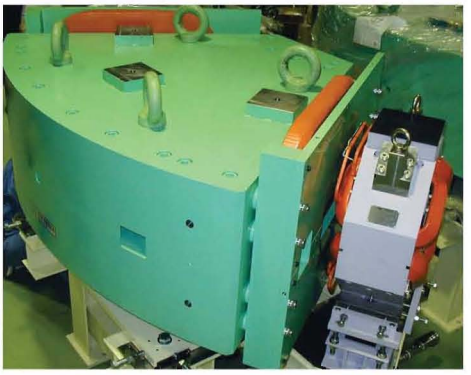

Figure 2 Top view of a bending magnet and a quadrupole magnet for S-LSR.

6 bending magnets is less than 10^{-4}. The filed stability is less than 10^{-5} [5].

S-LSR has also an electron cooler, which can cool various ion species and suited for the reserches, such as a short bunch beam formation, which can provide a new tool of the pulse radiolysis by ion beams [6]. S-LSR has a fast kicker to extract the short bunch beam.

1. Wei, J *et al.*, Phys. Rev. Lett. 73 (1994) 3089
2. Hangst, J.S. *et al.*, Phys. Rev. Lett. 67 (1991) 1238
3. Noda, A *et al.*, Proc. of the 2002 EPAC, France, (2002) 2750
4. Shirai, T *et al.*, Proc. of the 2002 EPAC, France, (2002) 623
5. Ikegami, M *et al.*, Proc. of SAST03 (2003) 184
6. Noda, K *et al.*, Proc. of the 2002 EPAC, France, (2002) 1380

Annual Meeting Phys. Soc. Jpn., 29 March, 2003.

Development of Quadrupole Magnet for Compact Ion Storage Ring, Takeuchi T, Shirai T, Ikegami M, Tongu H, Noda A *et al.*, Annual Meeting Phys. Soc. Jpn., 31 March, 2003.

Final Focus Lens using Super Strong Permanet Magnet Quadrupole in Linear Collider, Mihara T, Iwashita Y, Kumada M, Aoki M, The 14th Symposium on Accelerator Science and Technology, 11 Novemver, 2003.

Final Focus Lens using Permanent Magnet in Linear Collider, Iwashita Y, Kumada M, Aoki M *et al.*, Annual Meeting Phys. Soc. Jpn., 31 March, 2003.

Velocity Compliant Bunching Scheme with Amplitude Modulation, Iwashita Y, 5th International Workshop on Neutrino Factories, 6 June, 2003.

Grants

Noda A, Beam Accumulation and Cooler Ring, Advanced Compact Accelerator Research, April 2001 - March 2006.

Iwashita Y, Super Strong Permanent Magnet for Final Focus Lens in Linear Collider, Grant-in-Aid for Scientific Research, (A) (1), April 2002 - March 2006.

Iwashita Y, Basic Research on the Table-top Neutron Source, REIMEI Research Resources of JAERI, April 2003 - March 2004.